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JOHN MICHELS, Editor.

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DURING the year 1877 the Microscopical Section of the Indianapolis Lyceum of Natural History addressed a letter to the various Microscopical Societies throughout the United States, requesting expressions of their views touching the desirableness of a National Convention of the microscopists of the country, for the purpose of taking the necessary steps to form a National Association for the promotion of the progress of microscopical science, and for the benefit and advantage of all concerned therein.

Favorable replies having been received, THE NATIONAL MICROSCOPICAL CONGRESS, pursuant to a call, met at the Court house of Indianapolis, Indiana, on the 14th of August, 1878.

At this convention nearly fifty gentlemen, representing the Microscopical Societies of the United States, decided by a resolution, unanimously passed, that "IT IS DESIRABLE TO HAVE A NATIONAL ORGANIZATION FOR THE PROMOTION OF MICROSCOPICAL SCIENCE."

Thus THE AMERICAN SOCIETY OF MICROSCOPISTS was called into life, under the presidency of Dr. R. H. Ward, of Troy, N. Y. It met a second time at Buffalo, N. Y., on the 14th of August, 1879, and thirdly at Detroit, Michigan, on the 21st of August last.

It may be possible that the expectations of some persons in regard to the useful results of this Society have not been fulfilled; if such a feeling exists, we are not aware of its having been expressed; for our part we congratulate THE AMERICAN SOCIETY OF MICROSCOPISTS upon the results so far obtained, and feel sanguine for the good work it may accomplish in the future.

The address of the first president, Dr. R. H. Ward, was a model of its kind. The long extract we gave from it in "SCIENCE" for July 31, last, under the title of a "Plea for the Metric System in Microscopy," showed the master hand of an accomplished writer and earnest worker.

Dr. Ward's address was of a most practical nature, and well adapted to inspire enthusiasm; he dwelt upon the many instances in which the value of the microscope had been demonstrated, and recalled the many fields for microscopical work still fully open and recognized, but yet unoccupied, and concluded by showing that microscopical study might be made not only a source of pleasure to ourselves, but an effective aid to science and humanity.

The third annual meeting of this Society held under the Presidency of Professor H. L. Smith, of Geneva, N. Y., was fully reported in this journal on the 25th of September last.

As a professional microscopist Professor H. L. Smith, the second President, has so distinguished himself, that his reputation as an authority on the Diatomaceæ and other allied forms, is not confined to this continent, but acknowledged wherever such studies are intelligently pursued.

On referring to our report we find that Professor Smith congratulated the Society on its progress, and the meeting adjourned hopefully, after having elected as President for the new year Mr. J. D. Hyatt, of our city, a gentleman eminently qualified to occupy the chair of his predecessor.

Such being the history and present standing of THE AMERICAN SOCIETY OF MICROSCOPISTS, we notice with some surprise that the editor of the *American Monthly Microscopical Journal*, in his issue for September last, makes a proposition, to give this Society a *coup de grace*, by proposing that the Society shall disorganize, and its members join the Association for the Advancement of Science.

The reasons for such action are stated to be as follows: 1. The Society has not received the support of microscopists. 2. The officers of the Society have been inexperienced men, who have not directed it properly. 3. A supposed necessity created by the writer, that this Society must meet at the same place and time as the A. A. A. S., it being then infered that as the latter Society has a *subsection* of microscopy, there arises the difficulty of having two meetings on the same subject simultaneously; therefore one should be abandoned, the preference being given to the American Society of Microscopists for such act of self-sacrifice. 4. Can the American Society of Microscopists show any reason why it should exist? If it cannot, the inference is obvious.

This question having been raised in a journal devoted to microscopy, and by a gentleman who formed one of the original Committee of Organization, it appears only courteous to the writer, to direct the atten-

tion of microscopists to the subject. We suggest that they should give some expression of opinion, if they desire the integrity of this Society. For ourselves, we shall strongly support the maintenance of the American Society of Microscopists, on account of our decided faith in its usefulness, and necessity for its existence, and for the reason also, that no real cause has been shown for its disbandment.

Taking the charges of the editor of the *American Monthly Microscopical Journal* in the order presented, we would say: 1st. That we have the authority of the late President, Professor H. L. Smith, that the Society *has* received sufficient support to make it a success. 2d. That the Society has been unexceptionally fortunate in the selection of officers, that they have proved themselves to be experienced men, and *have* "directed properly." 3d. That the Society does not deem it necessary to meet in conjunction with the A. A. A. S., and has voted down all resolutions for so doing. The assertion to the contrary is therefore perfectly gratuitous, and the fact that those who propose it, also made it a reason for breaking up the Society, has the appearance of a desire to lead the Society to such an end. 4th. The demand made upon the Society by one of its members, to show cause why it should exist, appears slightly presumptuous and ill-timed. As a suggestion *before* the establishment of the society it might have had some weight, but after the third annual meeting, and the congratulations of its President on its success, the proposition is unseasonable. We would remind the editor of the *American Monthly Microscopical Journal*, when he challenges the American Society of Microscopists to show the *raisen d'etre* for its existence, that fifty delegates, representing the microscopists of the United States, in his presence passed a resolution in the following words: "*We think it desirable to have a National Organization for the promotion of Microscopical Science.*" We consider this a conclusive answer to the present querest, and to all others who in future raise such a question.

The article we have referred to states, that "if the American Society of Microscopists does not decide to meet next year in convention with the A. A. A. S., at Cincinnati, *that the next meeting will be its last.*" As the writer also states, that if it does so meet, the necessity will arise for it to be "disorganized," and as one of these alternatives is inevitable, the fate of the society would appear to be sealed.

As we believe these difficulties to be purely imaginary, we are ready to grant the American Society of Microscopists a long term of existence, and a future of utility and progress. If any of our readers are of a contrary opinion, our columns are open for an expression of their views.

LAW ACCORDING TO WHICH THE METALS, AND THEIR ORES, CAME TO, OR NEAR TO, THE SURFACE OF THE EARTH.

By Prof. Richard Owen, M.D., LL.D.

In the abstract of a paper read before the A. A. A. S., which appeared in the issue of "Science" for September 25, 1880, allusion was made, in the closing paragraph, to the connection between the law of land-forming and that of metallic development.

We might reasonably expect that the metals requiring temperatures from 2000 degrees to over 2500 degrees F. to melt them (such as iron and gold) would be the first to solidify, as our earth cooled; and therefore more likely to exist among older rocks than such metals as zinc, lead[1] and tin, which melt at a comparatively low temperature; and consequently could not become solid until the earth's crust had cooled to 773 degrees, 612 degrees, and 442 degrees, the melting points respectively of these metals. Such we find to be the fact. Furthermore, Faraday demonstrated that all substances, when suspended freely between the jaws of a powerful horseshoe magnet, would place themselves either *paramagnetically*, the same as iron and some other metals, or *diamagnetically*, the same as bismuth and numerous other bodies; and the magnetism developed, for the time being, in that horseshoe magnet, may be, and often is, produced by powerful currents of electricity.

It has been proved that there are constantly currents of electricity passing in the earth's crust, chiefly in an opposite direction from the earth's revolution, perhaps therefore operating mainly in causing a freely suspended needle to place itself at right angles to the plane of those so-called currents.

It seems therefore, further, not unreasonable to expect that metals, when about to solidify, if free to permeate cavities in all directions, should assume, relatively to these currents of electricity, respectively either a paramagnetic or a diamagnetic position. Such seems in reality to have been the case: Iron, manganese, platinum, nickel, cobalt (and probably other paramagnetic bodies, but time has not permitted this latter investigation) will be found chiefly occupying north and south belts, corresponding pretty generally with meridians, while gold, silver, copper, tin, lead, zinc, antimony, bismuth and other diamagnetic bodies will be found in east and west belts, sometimes on regular parallels, of which the terrestrial north pole is the centre, sometimes in east and west curves, having one or other of the Continental foci (pointed out in the law of land-forming) as their centre. The apparent law, then, briefly formulated, may be thus expressed:

The paramagnetic metals, in consolidating, arranged themselves along north and south belts, usually near the median line of each Continent, and are found in older rocks as well as newer. Diamagnetic metals are most commonly to be found in belts, not necessarily continuous, but running more or less east and west, end except perhaps in the case of gold, silver and cop-

[1] Although lead is found sometimes in silurian and carboniferous rocks, yet Dr. Dana shows (at page 148 of his Manual of Mineralogy) that such is not its true age. Speaking of Galena, he says: "In Derbyshire, England, the deposits contain fossils of permian rocks, showing that, although occurring in subcarboniferous limestone, they were much later in origin."

per, not so much in older rocks as in later formations. Demonstration:

I.—PARAMAGNETIC METALS AND THEIR ORES.

1. *Iron.*—A considerable portion of this metal as magnetite, both in the United States and in Scandinavia, is magnetic, possessing polarity. Specimens from Magnet Core, Ark., and from near Pilot Knob, Missouri, in the United States, and from Dannemora, in Sweden, present this character very strongly.

(*a*) Nearly all the important iron of the United States (as can be ascertained from Dana's Mineralogy, or readily seen by inspecting Map No. VIII in Cornell's Phys. Geogr.) occupies a north and south belt, between the meridians of 77° and 91° long. W. of Gr.) extending north and south from Lake Superior to Alabama, average lat., say 40°[2]. On the opposite side of the globe, this belt, prolonged in a great circle, will include the main iron belt of Asia.

(*b*) The iron of Europe is in a belt about (20) twenty degrees or nearly 800[3] statute miles in width, namely from long. 5° W. to long. 15° E., extending north and south from Scandinavia to Tunis: thus being about 90° distant from the American-Asiatic belt.

(*c*) The only other iron laid down in Cornell is in a belt from near the Urals to a deposit in Persia, half way between the European and the Central Asiatic iron belt, or about 45° distant from each of these.

(*d*) Dana mentions some iron in the region of San Francisco, which would be about 45° west of the Pennsylvania portion of the main United States belt.

2. *Manganese.*—The localities given by Dana for this metal would fall almost, if not entirely, within the iron belts of North America and Europe: showing a similar tendency to assume a paramagnetic direction.

3. *Platinum.*—The chief localities of platinum, as given in Dr. Dana's Manual of Mineralogy; namely, the Ural Mountains and North Granada, South America, as well as Canada and North Carolina, where traces have been found, fall within the United States iron belt. Borneo and places in Minas Geræs, Brazil, where some platinum has been taken out, are very slightly east of the above-named belt.

4. *Nickel and Cobalt.*—Ores of these metals are found, according to Dana, in Cornwall, Sweden, Norway, France, Saxony and the United States (Missouri, North Carolina, Pennsylvania): all again within one or other of the paramagnetic iron belts. Some nickel found in New Caledonia would occupy a position very nearly half way between the iron belt of Central Asia and the iron of California.

Without going into further details at present regarding the paramagnetic metals and their ores, let us examine some of the

II.—DIAMAGNETIC METALS AND THEIR ORES.

1. *Gold.* This metal cooling among the first on the globe is found in old formations; but appears to be also injected into, or deposited in, the fractures and fissures of rocks having a more recent age. The earlier east and west ranges or belts, in which it occurs more or less, often correspond, as already stated, with parallels of latitude; thus we find gold on a belt of the parallels 55° to 60° N. lat., comprising the gold of Alaska, Scotland, Sweden and the Urals; again in a belt ranging from lat. 45° to 50° N., embracing the gold of British Columbia, Washington Territory and Oregon, of Lake Superior, Canada and Nova Scotia, in North America. We find on the same parallels or belt, in the eastern continent, the gold of the Alps, Tyrol, Hungary and the Altai Mountains. Another zone or belt, in about lat. 35° to 38° N., runs from California and Arizona, through Georgia and North Carolina, and is prolonged through Spain, Thibet, China and Japan. A more southerly belt marks the gold of Central America and New Granada (United States of Colombia, S. A.), also of Western and Eastern Africa (about 5° N. of the Equator), as well as of Ceylon, Java and Borneo. The most southerly belt, in about lat. 22° to 32° S., embraces the South American gold localities, the gold washings of South Africa, the rich mines of Australia, and almost includes the gold of New Zealand.

In some cases, without making the belt so broad, gold localities can be traced on one and the same curve, using either the northern focus of each continent for a centre, or occasionally the more southern continental focus. For instance, using the Boothia Felix focus as a centre, an arc unites the gold of Oregon with that of Canada, while from the Lake Superior focus a curve sweeps from the gold of the Sierra Nevada and the Sacramento Valley in California to that of Georgia and North Carolina.

2. *Silver.* The most noted localities for this useful metal can be readily traced in North America, Europe and Asia, on belts running east and west, often at vertical intervals of about 4° to 5° apart, or say every 300 statute miles. Thus we have a belt from the silver of Norway to that in the Urals; then another, from Montana, Idaho, Wyoming and Lake Superior regions, continued through England, France and Saxony to the Altai Mountains; a third silver girdle runs from California and Arizona, through Utah and Colorado, thence to Spain. A fourth shows that of Mexico on the same parallel with the silver of China. Then come the rich mines of South America, in three successive belts (that of Venezuela, of Brazil and of Bolivia), with nothing to correspond in the eastern continent.

3. *Copper* can equally readily be traced along belts on diamagnetic parallels; such as one in Scandinavia connecting with the Urals. A second, on the parallel of the rich Lake Superior region takes in the copper of Cornwall, of France, Thuringia, Hungary, Siberia, China and Japan; a third can be found embracing the mines of Arizona, New Mexico, Tennessee and North Carolina, also of the Island of Cyprus, of Turkestan and Persia; a fourth gives us the copper of Cuba, Africa, Arabia and Hindostan, as shown in map No. VIII, of Cornell's Phy. Geogr., by Steinwehr. Of the two copper belts in S. America, the more Southerly is on the same parallel with the copper of Australia.

4. *Tin* (although sparingly distributed, except in two or three localities) follows the same rule: First belt, Massachusetts, New Hampshire, Cornwall (England), Saxony, Austria, and Russia. Second belt,

[2] A degree of longitude in latitude 40° is about 53 statute miles; consequently the width of the belt is nearly 750 miles.

[3] The average latitude of European iron being about 54° to 55° N., we may call a degree equal to 40 statute miles, thus giving the above result.

California and Spain. Third belt, Dureago (Mexico), Peru and China. Fourth belt, Malacca and Banca. Fifth. Bolivia, (S. America) Queensland and Northern New South Wales, in Australia, in about the parallel of 22° to 23° S. Lat.

5. *Lead.* The diamagnetic arrangement of the localities in which this metal is most abundantly found, may be rendered equally apparent, whether we follow the Galena and other ores in belts, on parallels around the globe, or connect these metallic deposits by curves from the Boothia Felix focus, for North America, and the Scandinavian focus for Europe. Thus, first belt in North America, from Arctic focus, Idaho, Wisconsin, Iowa, Northern Illinois, Vermont, New Hampshire and Maine; second belt, Nevada, Utah, Colorado, Missouri, Southern Illinois, New York, Connecticut; third belt, California, New Mexico, Arkansas, Tennessee, and North Carolina; fourth, Fort Yuma, and Arizona; fifth, the argentiferous Galena of Mexico.

In Europe there are from the Scandinavian focus four belts; first, that of Scotland and Saxony; second, of England and Bohemia; third, the lead mines of France; fourth, those of Spain, often argentiferous.

6. *Zinc.* From the Scandinavian focus, we trace one curve, which marks the zinc belt of England, Belgium and Germany; another that of France and Austria. In Asia, from the North Siberian focus, a belt connects the zinc of the Alati mountain with that of China. In the United States, if we take the Lake Superior focus as a center, we can bring within one belt the various zinc ores of Tennessee, Virginia, Pennsylvania, and the abundant deposits of New Jersey, as well as the zinc localities of New York, Vermont, New Hampshire and Maine.

7. *Antimony.* From the Lake Superior focus, a semicircle unites, in one belt, the ores of Antimony found in Maryland, New Hampshire and Maine, while just outside is a curve or zone uniting the mines worked in Sonora (Mexico) with those of New Brunswick.

In Europe, with Mount Rosa for a center, the Tertiary circles (radius nine degrees), described in the former communication, passes through the zinc of Cornwall (England), of Spain and of Hungary.

8. *Bismuth.* A belt in the United States, with Lake Superior for a center, unites the bismuth found in Montana, Arizona and Colorado, with that of Georgia and South and North Carolina.

In Europe, the bismuth of Norway and Sweden are in one curve from the Scandinavian focus; that of England, Saxony and Bohemia constitutes a second curve. Bismuth is also found in Australia, nearly on the parallel of latitude on which it is obtained in Chili and Bolivia (South America).

These demonstrations, or coincident facts, may, perhaps, suffice to test the truth of the law, which appears to be similar in character to that governing the formation of land.

Metals and metallic ores would seem, then, most frequently, to have arranged themselves, particularly when diamagnetic, as a large majority of bodies are, in curves, equi-distant from some dynamic focus.

It is hoped the above generalization may aid the miner and mineralogist in their search after mineral wealth.

THE UNITY OF NATURE.

By the Duke of Argyll.

II.

Man is included in the Unity of Nature, in the first place, as regards the composition of his body. Out of the ordinary elements of the material world is that body made, and into those elements it is resolved again. With all its beauties of form and of expression, with all its marvels of structure and of function, there is nothing whatever in it except some few of the elementary substances which are common in the atmosphere and the soil. The four principal gases, with lime, potash, and a little iron, sodium, and phosphorus, these are the constituents of the human body —of these in different combinations—and, so far as we know, of nothing else. The same general composition, with here and there an ingredient less or more, prevails throughout the whole animal and vegetable world, and its elements are the commonest in the inorganic kingdom also. This may seem a rude, and it is certainly a rudimentary view of the relation which prevails between ourselves and the world around us. And yet it is the foundation, or at least one of the foundations, on which all other relations depend. It is because of the composition of our body, that the animals and plants around us are capable of ministering to our support—that the common air is to us the very breath of life, and that herbs and minerals in abundance have either poisoning properties or healing virtue. For both of these effects are alike the evidence of some relation to the organism they affect; and both are in different degrees so prevalent and pervading, that of very few things indeed can it be said that they are wholly inert upon us. Yet there is no substance of the thousands which in one manner or another affect the body, which does not so affect it by virtue of some relation which it bears to the elements of which that body is composed, or to the combinations into which those elements have been cast.

And here we ascend one step higher among the facts which include Man within the unities of Nature. For he is united with the world in which he moves, not only by the elements of which his body is composed, but also by the methods in which those elements are combined—the forces by which they are held together, and the principles of construction according to which they are built up into separate organs for the discharge of separate functions. Science has cast no light on the ultimate nature of Life. But whatever it be, it has evidently fundamental elements which are the same throughout the whole circle of the organic world; the same in their relations to the inorganic; the same in the powers by which are carried on the great functions of nutrition, of growth, of respiration, and reproduction. There are, indeed, infinitely varied modifications in the mechanism of the same organs to accommodate them to innumerably different modes by which different animals obtain their food, their oxygen, and their means of movement. Yet so evident is the unity which prevails throughout, that physiologists are compelled to recognise the fundamental facts of organic life as "the same, from the lowest animal inhabiting a stagnant pool up to the glorious mechanism of the human form."[1]

This language is not the expression of mere poetic fancy, nor is it founded on dim and vague analogies. It is founded on the most definite facts which can be ascertained of the ultimate phenomena of organic life, and it expresses the clearest conceptions that can be formed of its essential properties. The creature which naturalists call the Amœba, one of the lowest in the animal series, consists of nothing but an apparently simple and formless jelly. But simple and formless as it appears to be, this jelly exhibits all the wonder and mystery of that power which we know as Life. It is in virtue of that power that the dead or inorganic elements of which it is composed are held together in a special and delicate combination, which no other power can preserve in union, and which begins to dissolve the moment that power departs. And as in virtue of this power the constituent elements are held in a peculiar relation to each other, so in virtue of the same power does the combination possess peculiar relations with external things. It has the

[1] On the Nervous System, by Alex. Shaw. Appendix to Sir Charles Bell's "Anatomy of Expression."

faculty of appropriating foreign substances into its own, making them subservient to the renewal of its own material, to the maintenance of its own energy, and to the preservation of its own separate individuality. It has the faculty, moreover, of giving off parts of itself, endowed with the same properties, to lead a separate existence. This same substance, which when analyzed has always the same chemical composition, and when alive has always the same fundamental properties, is at the root of every organism, whether animal or vegetable. Out of its material all visible structure is built up, and the power which holds its elements together is the same power which performs the further work of molding them into tissues—first forming them, and then feeding them, and then keeping them in life. This is as true of the highest organism of Man as it is of the lowest, in which visible structure begins to be. The phenomena of disease have convinced physiologists that all the tissues of the body are freely penetrated by the protoplasmic corpuscles of the blood, and that the primordial properties displayed in the substance of an Amœba, which has no distinguishable parts and no separate organs, afford the only key to the fundamental properties of every animal body. One eminent observer assigns so high a place to this protoplasmic matter as the primary physical agent in the building of the House of Life, and in its renovation and repair, that he considers all its other materials, and all its completed structures as comparatively "dead."

But the unity of Man's body with the rest of Nature lies deeper still than this. The same elements and the same primary compounds are but the foundations from which the higher unities arise. These higher unities appear to depend upon and to be explained by this—that there are certain things which must be done for the support of animal life, and these things are fundamentally the same from the lowest to the highest creatures. It is for the doing of these things that "organs" are required, and it is in response to this requirement that they are provided. Food—that is to say, foreign material—must be taken in, and it must be assimilated. The circulating fluids of the body must absorb oxygen; and when this cannot be done more simply, a special apparatus must be provided for the separation of this essential element of life from the air or from the water. Sensation must be localized and adapted to the perception of movements in surrounding media. The tremors of the atmosphere and of the luminiferous ether must first be caught upon responsive—that is to say, upon adapted—surfaces, and then they must be translated into the language of sensation—that is to say, into sight and hearing. The heat evolved in the chemical processes of digestion and of oxygenation of the blood must be made convertible into other forms of motion. The forces thus concentrated must be stored, rendered accessible to the Will, and distributed to members which are at its command. These and and many other uniform necessities of the animal frame constitute a unity of function in organs of the widest dissimilarity of form, so that however different they may be in shape, or in structure, or in position, they are all obviously reducible to one common interpretation. They do the same things—they serve the same purposes—they secure the same ends—or, to use the language of physiology, they discharge the same functions in the animal economy.

But more than this; even the differences of form steadily diminish as we ascend in the scale of being. Not only are the same functions discharged, but they are discharged by organs of the same general shape, formed on one pattern, and occupying an identical position in one plan of structure. It is on this fact that this science of comparative anatomy is founded, and the well-established doctrine of "homologies." The homology of two organs in two separate animals is nothing but the unity of place which they occupy in a structure which is recognized as one and the same in a vast variety of creatures—a structure which is one in its general conception, and one in the relative arrangement of its parts. In this clear and very definite sense, the body of Man, as a whole, is one in structure with the bodies of all vertebrate animals; and as we rise from the lowest of these to him who is the highest, we see that same structure elaborated into closer and closer likeness, until every part corresponds—bone to bone, tissue to tissue, organ to organ. It is round this fact that so many disputants are now fighting. But all the controversy arises, not as to the existence of the fact, but as to its physical cause. The fact is beyond question. In a former work[2] I have dwelt at some length on the bearing of this fact on our conceptions of "Creation by Law," and on the various theories which assume that such close relationship in organic structure can be due to no other cause than blood relationship through ordinary generation. At present I am only concerned with the fact of unity, whatever may be the physical cause from which that unity has arisen. The significance of it, as establishing Man's place in the unity of Nature, is altogether independent of any conclusion which may be reached as to those processes of creation by which his body has been fashioned on a plan which is common to him and to so many animals beneath him. Whether Man has been separately created out of the inorganic elements of which his body is composed, or whether it was born of matter previously organized in lower forms, this community of structure must equally indicate a corresponding community of relations with external things, and some antecedent necessity deeply seated in the very nature of those things, why his bodily frame should be like to theirs.

And, indeed, when we consider the matter, it is sufficiently apparent that the relationship of Man's body to the bodies of the lower animals is only a subordinate part and consequence of that higher and more general relationship which prevails between all living things and those elementary forces of Nature which play in them, and around them, and upon them. If we could only know what that relationship is in its real nature and in its full extent, we should know one of the most inscrutable of all secrets. For that secret is no other than the ultimate nature of Life. The great matter is to keep the little knowledge of it which we possess safe from the confusing effect of deceptive definitions. The real unities of Nature will never be reached by confounding her distinctions. For certain purposes it may be a legitimate attempt to reduce the definition of Life to its lowest terms—that is to say, it may be legitimate to fix our attention exclusively on those characteristics which are common to Life in its lowest and in its highest forms, and to set aside all other characteristics in which they differ. It may be useful sometimes to look at Life under the terms of such a definition, in order, for example, the better to conceive some of its relations with other things. But in doing so we must take care not to drop out of the terms so defining Life anything really essential to the very idea of it. Artificial definitions of this kind are dangerous experiments in philosophy. It is very easy by mere artifices of language to obliterate the most absolute distinctions which exist in Nature. Between the living and the non-living there is a great gulf fixed, and the indissoluble connection which somehow, nevertheless, we know to exist between them is a connection which does not fill up that gulf, but is kept up by some bridge being, as it were, artificially built across it. This unity, like the other unities of Nature, is not a unity consisting of mere continuity of substance. It is not founded upon sameness, but, on the contrary, rather upon difference, and even upon antagonisms. Only the forces which are thus different and opposed are subordinate to a system of adaptation and adjustment. Nor must we fail to notice the kind of unity which is implied in the very words "adaptation" and "adjustment"—and, above all others, in the special adjustments connected with organic Life. There are many unions which do not involve the idea of adjustment, or which involve it only in the most rudimentary form. The mere chemical union of two or more elements—unless under special conditions—is not properly an adjustment. We should not naturally call the formation of rust an adjustment between the oxygen of the atmosphere and metallic iron. When the combinations effected by the play of chemical affinities are brought about by the selection of elements so placed within reach of each other's reactions as to result in a given product, then that product would be accurately described as the result of co-ordination and adjustment. But the kind of co-ordination and adjustment which appears in the facts of Life is of a still higher and more complicated kind than this. Whatever the relationship may be between living organisms and the elements, or elementary forces of external Nature, it certainly is not the relationship of mere chemical affinities. On

[2] "The Reign of Law."

the contrary, the unions which these affinities by themselves produce can only be reached through the dissolution and destruction of living bodies. The subjugation of chemical forces under some higher form of energy, which works them for the continued maintenance of a separate individuality—this is of the very essence of Life. The destruction of that separateness is of the very essence of death. It is not Life, but the cessation of Life, which, in this sense and after this manner, effects a chemical union of the elements of the body with the elements around it. There is indeed an adjustment—a close, an intricate adjustment—between these and the living body; but it is an adjustment of them under the controlling energy of a power which cannot be identified with any other, and which always presents phenomena peculiar to itself. Under that power we see that the laws and forces of chemical affinity, as exhibited apart from Life, are held, as it were, to service—compelled, indeed, to minister but not allowed to rule. Through an infinite variety of organisms, this mysterious subordination is maintained, ministering through an ascending series to higher and higher grades of sensation, perception, consciousness, and thought.

And here we come in sight of the highest adjustment of all. Sensation, perception, consciousness, and thought—these, if they be not the very essence of Life, are at least—in their order—its highest accompaniments and result. They are the ultimate facts, they are the final realities, to which all lesser adjustments are themselves adjusted. For, as the elementary substances and the elementary forces of Nature which are used in the building of the body are there held by the energies of Life under a special and peculiar relation to those same elements and to those same forces outside the body, so also are they held in peculiar relations to those characteristic powers in which we are compelled to recognize the rudimentary faculties of mind, Sensation is the first of these, and if it be the lowest, it is at least the indispensable basis of all the rest. As such, it cannot be studied too attentively in the first stages of its appearance, if we desire to understand the unity of which it is the index and result. We have seen that the mechanism of living bodies is one throughout the whole range of animal Life—one in its general plan, and one even in the arrangement of many of its details. We have seen, too, that this unity rests upon that other—in virtue of which all organisms depend for the maintenance of their life, upon adjustments to certain physical laws which are held, as it were, in vassalage, and compelled to service; doing in that service what they never do alone, and not doing in that service what they always do when freed from it.

And now we have to ask what that service is? We can only say that it is the service of Life in all its manifestations, from those which we see in the lowest creatures up to the highest of which, in addition, we are conscious in ourselves. I say "in addition"—because this is the fundamental lesson of physiology and of comparative anatomy—that the principle and the mechanism of sensation are the same in all creatures, at least in all which have the rudiments of a nervous system. This identity of principle and of structure in the machinery of sensation, taken together with the identity of the outward manifestations which accompany and indicate its presence in animals, makes it certain that in itself it is everywhere the same. This does not mean, of course—very far from it—that the range of pleasure or of pain consequent on sensation—still less the range of intelligent perception—is the same throughout the animal kingdom. The range of pleasure or of pain, and still more the range of intelligent perception, depends on the association of higher faculties with mere sensation, and upon other peculiarities or conditions of organization. We all know by our own experience, when comparing ourselves with ourselves in different states of health or of disease, and by observing the like facts in others, that the degree of pleasure or of suffering, of emotion or of intellectual activity, which is connected with sensation, may be almost infinitely various according to various conditions of the body. But this does not affect the general proposition that sensation is in itself one thing throughout the animal kingdom. It cannot be defined in language, because all language is founded on it, assumes it to be known, and uses the metaphors it supplies for the expression of our highest intellectual conceptions. But though it cannot be defined, this at least we can say concerning it, that sensation is the characteristic property of animal life; that it is an affection of the "anima," of that which distinguishes animate from inanimate things, and that as such it constitutes one of the most essential of the fundamental properties of mind. So true is this, that the very word "idea," which has played a memorable part in the history of speculation, and which in common speech has now come to be generally associated with the highest intellectual abstractions, has had in modern philosophy no other definite meaning than the impressions or mental images received through the senses. This is the meaning attached to it (although, perhaps, no writer has ever adhered to it with perfect consistency) in the writings of Descartes, of Locke, and of Bishop Berkeley; and it is well worthy of remark that the most extreme doctrine of Idealism, which denies the reality of matter, and, indeed, the reality of everything except mind, is a doctrine which may be as logically founded upon sensation in a Zoophyte as upon sensation in a Man. The famous proposition of Bishop Berkeley, which he considers as almost self-evidently true, "that the various sensations, or ideas imprinted on the sense, cannot exist otherwise than in the mind perceiving them," is a proposition clearly applicable to all forms of sensation whatever. For every sensation of an organism is equally in the nature of an "idea" in being an affection of the living principle, which alone is susceptible of such affections; and it is plainly impossible to conceive any sense-impression whatever as existing outside a living and perceiving creature.

We are now, indeed, so accustomed to attach the word "idea" to the highest exercises of mind, and to confine the word "mind" itself to some of its higher manifestations, that it may startle some men to be told that sensation is in itself a mental affection. We have, however, only to consider for a moment how inseparably connected sensation is with appetite and with perception, to be convinced that in the phenomena of sensation we have the first raw materials and the first small beginnings of Intelligence and of Will. It is this fundamental character of sensation which explains and justifies the assertion of philosophers—an assertion which at first sight appears to be a mere paradox—that the "ideas" we receive through the senses have no "likeness" to the objects they represent. For that assertion, after all, means nothing more than this—that the impressions made by external things upon living beings through the senses, are in themselves mental impressions, and as such cannot be conceived as like in their own nature to inanimate and external objects. It is the mental quality of all sensation, considered in itself, which is really affirmed in this denial of likeness between the affections of sense and the things which produce those affections in us. It is one of the many forms in which we are compelled to recognize the inconceivableness of any sort of resemblahce between Mind and Matter, between external things and our own perceptive powers.

And yet it is across this great gulf of difference—apparently so broad and so profound—that the highest unity of Nature is nevertheless established. Matter built up and woven into "organs" under the powers of Life is the strong foundation on which this unity is established. It is the unity which exists between the living organism and the elements around it which renders that organism the appropriate channel of mental communication with the external world, and a faithful interpreter of its signs. And this the organism is—not only by virtue of its substance and composition, but also and especially by virtue of its adjusted structures. All the organs of sense discharge their functions in virtue of a purely mechanical adjustment between the structure of the organ and the particular form of external force which it is intended to receive and to transmit. How fine those adjustments are can best be understood when we remember that the retina of the eye is a machine which measures and distinguishes between vibrations which are now known to differ from each other by only a few millionths of an inch. Yet this amount af difference is recorded and made instantly appreciable in the sensations of color by the adjusted mechanism of the eye. Another adjustment, precisely the same in principle, between the vibrations of Sound and the structure of the ear, enables those vibrations to be similarly distinguished in another

special form of the manifold language of sensation. And so of all the other organs of sense—they all perform their work in virtue of that purely mechanical adjustment which places them in a given relation to certain selected manifestations of external force, and these they faithfully transmit, according to a code of signals, the nature of which is one of the primary mysteries of Life, but the truthfulness of which is at the same time one of the most certain of its facts.

For it is upon this truthfulness—that is to say, upon a close and efficient correspondence between the impressions of sense and certain realities of external Nature—that the success of every organism depends in the battle of life. And all Life involves a battle. It comes indeed to each animal without effort of its own, but it cannot be maintained without individual exertion. That exertion may be of the simplest kind, nothing more than the rhythmic action of a muscle contracting and expanding so as to receive into a sac such substances as currents of water may bring along with them; or it may be the more complex action required to make or induce the very currents, which are to bring the food; or it may be the much more complex exertions required in all active locomotion for the pursuit and capture of prey; all these forms of exertion exist, and are all required in endless variety in the animal world. And throughout the whole of this vast series the very life of every creature depends on the unity which exists between its sense-impressions and those realities of the external world which are specially related to them. There is therefore no conception of the mind which rests on a broader basis of experience than that which affirms this unity—a unity which constitutes and guarantees the various senses with their corresponding appetites, each in its own sphere of adapted relations to be exact and faithful interpreters of external truth.

A still more wonderful and striking proof is obtained of the unity of Nature, and a still more instructive light is cast upon its source and character, when we observe how far-reaching these interpretations of sense are even in the very lowest creatures; how they are true not only in the immediate impressions they convey, but true also as the index of truths which lie behind and beyond—of truths, that is to say, which are not expressly included—not directly represented—in either sensation or perception. This, indeed, is one main function and use, and one universal characteristic of all sense-impressions, that over and above the pleasure they give to sentient creatures, they lead and guide to acts required by natural laws which are not themselves objects of sensation at all, and which therefore the creatures conforming to them cannot possibly either see or comprehend. It is thus that the appetite of hunger and the sense of taste, which in some form or other, however low, is perhaps the most universal sensation of animal organisms, is true not only as a guide to the substances which do actually gratify the sense concerned, but true also in its unseen and unfelt relations with those demands or laws of force which render the assimilation of new material an indispensable necessity in the maintenance of animal life. Throughout the whole kingdom of Nature this law prevails. Sense-perceptions are in all animals indissolubly united with instantaneous impulses to action. This action is always directed to external things. It finds in these things the satisfaction of whatever desire is immediately concerned, and beyond this it ministers to ends of which the animal knows nothing, but which are of the highest importance both in its own economy and in the general economy of Nature.

The wonderful instincts of the lower animals—the precision and perfection of their work—are a glorious example of this far-reaching adjustment between the perceptions of sense and the laws which prevail in the external world. Narrow as the sphere of those perceptions may be, yet within that sphere they are almost absolutely true. And although the sphere is indeed narrow as regards the very low and limited intelligence with which it is associated in the animals themselves, it is a sphere which beyond the scope of their intelligence can be seen to place them in unconscious relation with endless vistas of co-ordinated action. The sentient actions of the lower animals involve not merely the rudimentary power of perceiving the differences which distinguish things, but the much higher power of profiting by those relations between things which are the foundation of all voluntary agency, and which place in the possession of living creatures the power of attaining ends through the employment of appropriate means. The direct and intuitive perception of things which stand in the relation of means to ends, though it may be entirely dissociated from any conscious recognition of this relation in itself—that is to say, the direct and intuitive perception of the necessity of doing one thing in order to attain to another thing—is in itself one of the very highest among the preadjusted harmonies of Nature. For it must be remembered that those relations between things which render them capable of being used as means to ends are relations which never can be direct objects of sensation, and therefore the power of acting upon them is an intuition of something which is out of sight. It is a kind of dim seeing of that which is invisible. And even if it be separated entirely in the lower animals—as it almost certainly is—from anything comparable with our own prescient and reasoning powers, it does not the less involve in them a true and close relation between their instincts and the order of Nature with its laws.

The spinning machinery which is provided in the body of a spider is not more accurately adjusted to the viscid secretion which is provided for it, than the instinct of the spider is adjusted both to the construction of its web and also to the selection of likely places for the capture of its prey. Those birds and insects whose young are hatched by the heat of fermentation have an intuitive impulse to select the proper materials, and to gather them for the purpose. All creatures, guided sometimes apparently by senses of which we know nothing, are under like impulses to provide effectually for the nourishing of their young. It is, moreover, most curious and instructive to observe that the extent of prevision which is involved in this process, and in the securing of the result, seems very often to be greater as we descend in the scale of Nature, and in proportion as the parents are dissociated from the actual feeding or personal care of their young. The Mammalia have nothing to provide except food for themselves, and have at first, and for a long time, no duty to perform beyond the discharge of a purely physical function. Milk is secreted in them by a purely unconscious process, and the young need no instruction in the art of sucking. Birds have much more to do—in the building of nests, in the choice of sites for these, and after incubation in the choice of food adapted to the period of growth. Insects much lower in the scale of organization, have to provide very often for a distant future, and for stages of development not only in the young but in the *nidus* which surrounds them.

There is one group of insects, well-known to every observer—the common Gall-flies—which have the power of calling on the vegetable world to do for them the work of nest-building; and in response to the means by which these insects are provided, the Oak or the Rose does actually lend its power of growth to provide a special *nidus* by which the plant protects the young insect as carefully as it protects its own seed. Bees, if we are to believe the evidence of observers, have an intuitive guidance in the selection of food, which has the power of producing organic changes in the bodies of the young, and by the administration of which, under what may be called artificial conditions, the sex of certain selected individuals can be determined, so that they may become the mothers and queens of future hives.

These are but a few examples of facts of which the whole animal world is full, presenting, as it does, one vast series of adjustments between bodily organs and corresponding instincts. But this adjustment would be useless unless it were part of another adjustment between the instincts and perceptions of animals and those facts and forces of surrounding Nature which are related to them, and to the whole cycle of things of which they form a part. In those instinctive actions of the lower animals which involve the most distant and the most complicated anticipations, it is clear that the prevision which is involved is a prevision which is not in the animals themselves. They appear to be guided by some simple appetite, by an odor or a taste, and they have obviously no more consciousness of the ends to be subserved, or of the mechanism by which they are secured, than the suckling has of the processes of nutrition.

The path along which they walk is a path which they did not engineer. It is a path made for them, and they simply follow it. But the propensities and tastes and feelings which make them follow it, and the rightness of its direction towards the ends to be obtained, do constitute a unity of adjustment which binds together the whole world of Life, and the whole inorganic world on which living things depend.

I have called this adjustment mechanical, and so, in the strictest sense, it is. We must take care, however, not to let our conceptions of the realities of Nature be rendered indistinct by those elements of metaphor which abound in language. These elements, indeed, when kept in their proper places, are not only the indispensable auxiliaries of thought, but they represent those perceptions of the mind which are the highest and the most absolutely true. They are the recognition—often the unconscious recognition—of the central unities of Nature. Nevertheless, they are the prolific source of error when not closely watched. Because all the functions and phenomena of Life appear to be strictly connected with an apparatus, and may therefore be regarded as brought about by adjustments which are mechanical, therefore it has been concluded that those phenomena, even the most purely mental, are mechanical in the same sense in which the work is called mechanical which human machines perform. Are not all animals "automata?" Are they not "mere machines?" This question has been revived from age to age since philosophy began, and has been discussed in our own time with all the aid which the most recent physiological experiment can afford. It is a question of extreme interest in its bearing on our present subject. The sense in which, and the degree to which, all mental phenomena are founded on, and are the result of mechanical adjustments, is a question of the highest interest and importance. The phenomena of instinct, as exhibited in the lower animals, are undoubtedly the field of observation in which the solution of this question may best be found, and I cannot better explain the aspect in which it presents itself to me, than by discussing it in connection with certain exhibitions of animal instinct which I had occasion to observe during the spring and summer of 1874. They were not uncommon cases. On the contrary, they were of a kind of which the whole world is full. But not the less directly did they suggest all the problems under discussion, and not the less forcibly did they strike me with the admiration and the wonder which no familiarity can exhaust.

IMPROVEMENT OF THE MISSISSIPPI RIVER.*

By Prof. W. H. Ballou.

The Mississippi River is the most gigantic parasite known to men. The least possible estimate, computed from data in hand, shows that the annual average for the last thirty years, of money expended on it for improvements, and lost through its depredations, exceeds $7,000,000. Fully one-third of this sum is used by the government, States and private individuals to keep the stream and its tributaries in an "improved condition." The table will show the average of the expenditures obtained for the last thirty years :

Expenditures of the States of Mississippi, Louisiana and Arkansas on levees since 1849	$100,090,000
Expended by the government and private individuals—estimate	50,000,000
Damage by floods, ice gorges, etc., to levees, property, life etc.	80,000,000
Total	$230,090,000
Average per annum, $7,669,666.	
To this may be added 26,772,379 acres of land granted to the above States by the government in 1849, the value being about $10 per acre	267,773,790
Total	$497,813,790
Average per year, $16,000,000.	

Only those who are acquainted with the stream and its peculiarities have an idea how unmanageable it is. The unstable condition of the soil of the country through which it flows renders it an object of distrust to the inhabitants of its border. Such is the treacherous condition of its relations that for sixty-two years the ingenuity of man has contrived no check on its action. The causes of this condition of things are found partly in the river-bed. The sedimentary deposit varies from 60 to 100 feet in depth. It is generally composed of silt, with a mixture of clay and sand, which, having been deposited by the river, is at its disposal to lie still or be shifted about. It is evident that no ordinary construction can long stand unless it has a foundation penetrating this bed to a rock stratum. The great bridge at St. Louis, for instance, has its piers resting on the limestone bed-rock, under a sedimentary deposit of seventy feet. The railway bridge at the mouth of the Minnesota river has its piers lodged on a slender stratum of hard earth sixty feet beneath the river's bottom. It is further admitted that in boring through this stratum a soft layer was struck, which would not uphold the rod's weight. At Cairo, Ill., in 1877, the United States corps of engineers, under Lieutenant D. W. Lockwood, made borings to a depth of 87 feet without encountering any stratum harder than sand. At this point the machinery broke down and operations were suspended. At a depth of 33 feet the auger penetrated a cottonwood log, hardly ready to decay, showing conclusively the facility with which the river makes its own bed. At the same place it is stated on good authority that piles, one on another, have been driven to a depth of 125 feet without encountering a rocky stratum.

The story of its great width is even more remarkable. Near Cairo, Ill., the river moved a mile out of its course in one year, and is continually changing at that point. Still more remarkable are the operations of the Missouri river. At one time Council Bluffs enjoyed its presence in the immediate proximity, and the benefits of its commerce, in consequence of which the city became the terminus for Western railways in preference to Omaha, three times its size. These railroads erected depots and stationed offices of general Western superintendents there. The Union Pacific constructed an immense bridge, and in common with other railways built a union depot at the Bluffs. No sooner was the work completed, than the Missouri performed the rare feat of moving its course to Omaha, three miles away. There is no end to instances of this kind on a smaller scale. It may be safely asserted that from its narrowest point the Mississippi varies to twenty miles in width. It is no wonder, then, that the present embankment system is inadequate. Appropriations are only asked at present for embankments as far north as Cairo. It is evident, however, that the sedimentary bed extended nearly to the source of the Mississippi, and that not only must the 110 miles from New Orleans to Cairo be embanked, but also the greater shore line above the latte city on both this river and the Missouri. An explanation of the frequent destruction of levees, dikes and embankments is found in the method of their construction. When the current leaves the middle and runs along one side of the stream, the bank is rapidly torn down. At this point the corps of engineers proceed to build a dike to resist the destructive force. A rip-rap is first constructed which consists of a raft covered with long poles, placed cross-wise in alternate layers. This is loaded with heavy stones and sunk near the shore. Outside of it long poles are driven to a depth of twenty or thirty feet, and sometimes to twice these depths. Brush and stones are heaped upon their foundation until a perpendicular embankment is completed on a level with the top of the bank. One would think that this ponderous dike would stand for ages. But so vacillating is the silt bed underneath that the water keeps working the outer edge with powerful results. The embankment settles, sometimes toppling over, and again dropping suddenly from sight. Often the water works in behind these constructions and leaves them out in the stream. Thus it happens that the river is at work at innumerable points, tearing away its banks and defying the structures in use to hold it in check.

In its work of destruction the current has some formidable aids. In the winter ice floats down continually. So immense are these cakes at times that three, and even two coming down stream abreast will get caught on the sides of the river, in some narrow channel, and form a bridge. This bridge effectually holds back all oncoming ice. The great and small cakes coming down in large quantities join under, over and behind the bridge, piling up to a great height, forming a gigantic gorge. This mass finally breaks away ; no power yet inaugurated by the hand of man is able to withstand it. Embankments, boats, live stock, people,

* Read before the A. A. A. S., Boston, 1880.

forests, houses, other property are borne down stream. One gorge alone has been known to sweep away $3,000,000 worth of property, besides making a tremendous destruction of life. A gorge will often require three days to pass a given point.

Another enemy to investigation and to embankments are the snags which infest the river. These, in their worst form, are large trees with roots and limbs. So rapidly are they loosened and borne down that the government is required to keep several snag boats constantly at work. Perhaps the greatest of all enemies to embankments is the period of high water. At this time most of the country adjoining the river, known as the "bottom lands," is flooded to a greater or less depth. This is a most dangerous period, the result of which is awaited with anxiety by land-owners involved. The various floods occurring since 1850, principally in that year, and those of 1864 and 1874, have carried away 200 miles of embankment between New Orleans and Cairo alone, which will cost the government alone $6,000,000 to repair.

There are many schemes offered for the construction of permanent embankments. Some are practicable to an extent, and others are but empty air. It is evident, however, that the government can never secure sufficient funds to inaugurate a system of embankments which shall have a foundation resting on the bed-rock below the river's bottom. Captain Charles M. Scott proposes a method which is, in brief, to weight and sink a reach of trees with their roots in such a manner as shall change or keep the current within bounds. A careful consideration of this method shows that after every high-water season these trees would be "reaching" in all directions along the river. Captain James B. Eads once proposed a system of ditches which shall narrow the river in wide places and compel the current to cut a deeper channel. As I understand this method, it is hardly practicable. There are other methods proposed. That of Captain Cowden is, perhaps, worthy of trial, though I am compelled to believe that it must be accompanied by a permanent system of levees. A very simple method, which has a semblance of practicability, is being experimented on near Omaha and at Nebraska City by Major C. R. Suter. An examination of this exhibits a simplicity which may circumvent the action of the water. No rip-rap is sunk and no piles are driven down. The sloping bank is covered with a mattress of brush. Stones are piled on this to a thickness of seven or eight feet, which holds the bank in its place and retains its sloping form. The water seems to have little inclination to work under this as in the case of a perpendicular embankment. I believe it is the invention, for the most part, of Professor L. E. Cooley, late professor of Engineering in the Northwestern University at Evanston, Ill., and now in charge of the works at Nebraska City, Major Suter also employs a simple and inexpensive method of changing the current of the river where it is wearing away the bank. A line is fastened to a buoy near the centre. Branches of trees are tied along one-half of this, leaving the other half bare. Anchors are attached at both ends of the rope and the half without bushes is run up the river as a guy, while the buoy holds up the centre of the rope at the surface. A line of brush then runs from the surface diagonally to the bottom. A series of these is placed out in the stream near where the damage is being done. The sediment coming down stream catches on the brush, sinks and forms a bar, and either breaks the force of the current or throws it out into the stream away from the endangered bank. This latter method has long been in use by the Corps of Royal Engineers with success.

Hegar's formula for an effective non-poisonous preservative and antiseptic is as follows:

℞	Salicylic acid	20 parts.
	Boracic acid	25 "
	Potassium carbonate	5 "
	Dissolve in hot water	500 "
	Glycerine	200 "
	Then add oil of cinnamon, oil of cloves, each 15 parts, dissolved in alcohol	500 "

It is an exterminator of moths and vermin and has a pleasant odor.

ON THE NUTRITIVE VALUE OF FISH.*

By Prof. W. O. Atwater.

This paper gives the results of an investigation made under the auspices of the Smithsonian Institution and the United States fish commission. They included analyses of a large number of specimens of more common food fishes, whose details, though quite extended, were mainly of theoretical value. Some of the applications, however, were of much practical interest. In 100 pounds of the flesh of fresh cod we have 83 pounds of water and only 17 pounds of solids, while the flesh of the salmon contains only 66½ per cent. of water and 33½ per cent. of solids; that is to say, about one-sixth of the flesh of cod and one-third of that of salmon consists of solid, that is, nutritive substances, the rest being water. Lean beef, free from bone, contains about seventy-five per cent. water and twenty-five per cent. solids. The figures for some of the more common sorts of fish were:

	Solids, per cent.		Solids, per cent.
Flounder	17.2	Halibut, fat	30.7
Cod	16.9	Mackerel	22.2
Striped bass	20.4	Shad	30.7
Bluefish	21.8	Whitefish	30.4
Halibut, lean	20.6	Salmon	33.6

If we take into account not the flesh only but the whole fish as sold in the market, including bones, skin and other waste, the actual percentages of nutritive material, is, of course, smaller. Thus the following percentages of edible solids were found in samples analyzed:

Flounders	7.1	Shad	14.8
Cod	10.5	Shad	18.7
Mackerel	11.4	Lake trout	13.6
Halibut, lean	15.6	Salmon	25.6
Halibut, fatter	22.2		

The subject has of late attracted unusual attention. The chemico-physiological investigation of the past two decades has brought us where we can judge with a considerable degree of accuracy from the chemical composition of a food-material what is its value for nourishment as compared with other foods. The bulk of the best late investigation of this subject has been made in Germany where a large number of chemists and physiologists are busying themselves in the experimental study of the laws of animal nutrition. They have already got so far as to feel themselves warranted in computing the relative values of our common foods, and arrange them in tables, which are coming into popular use. The valuations are based upon the amounts of albuminoids, carbo-hydrates and fats, each being rated at a certain standard, just as a grocer makes out his bill for a lot of sugar, tea and coffee, by rating each at a certain price per pound, and adding the sums thus competed to make the whole bill. A table was given showing the composition of a list of animal foods. Thus it appeared that, while medium beef has about three-fourths water and one-fourth solids, milk is seven-eighths water and one-eighth solids. Assuming a pint of milk to weigh a pound, and speaking roughly, a quart of milk and a pound of beefsteak would both contain the same amount—about four ounces—of solids. But the quart of milk would not be worth as much for food as the pound of steak. The reason is that the nutrients of the steak are almost entirely albuminoid, while the milk contains a good deal of carbo-hydrates and fats, which have a lower nutritive value. According to the valuations given, taking medium beef at 100, we should have for like weights of flesh free from bone:

Medium beef	100.0	Bluefish	85.0
Fresh milk	23.8	Mackerel	86.0
Skimmed milk	18.5	Halibut	88.c
Butter	124.0	Lake trout	94.0
Cheese	155.0	Eels	95.0
Hens' eggs	72.0	Shad	99.0
Cod (fresh fish)	68.0	Whitefish	103.0
Flounders	65.0	Salmon	104.0
Halibut	88.0	Salt mackerel	111.0
Striped bass	79.0	Dried codfish	346.0

These figures differ widely from the market values. But we pay for our food according, not to their value for nourishing our bodies, but to their agreeableness. Taking the samples of fish at their retail prices in the Middletown, Conn., markets, the total edible solids in striped bass came to about $2.30 a pound, while the Connecticut river shad's

* Read before the A. A. A. S. Boston, 1880.

nutritive material was bought at 44 cents per pound. The cost of the nutritive material in one sample of halibut was 57 cents, and in the other $1.45 per pound, though both were purchased in the same place at the same price—15 cents per pound, gross weight. In closing, Professor Atwater referred to the widespread but unfounded notion that fish is particularly valuable for brain food on account of its large content of phosphorus. Suffice it to say that there is no evidence as yet to prove that the flesh of fish is specially richer in phosphorus than other meats are, and that, even if it were so, there is no proof that it would be on that account more valuable for brain food. The question of the nourishment of the brain and the sources of intellectual energy are too abstruse for speedy solution in the present condition of our knowledge.

ANATOMY OF THE TONGUE IN SNAKES AND OTHER REPTILES, AND IN BIRDS.*

By Dr. C. S. Minot.

The tongue arises as a protuberance on the floor of the mouth, which in the course of development acquires a muscular system; the latter appears first in the reptiles. The principal muscles are the longitudinal arising from the hyoid bones, morphologically a part of the branchial muscles. In the crocodiles these are the only muscles found. In the snakes, however, proper lingual muscles play an important part, there being a distinct vertical muscle between the *Ceratoglossi*, three distinct transverse muscles, one superior and two inferior, and finally a longitudinal muscle immediately under the upper surface of the free portion of the tongue. Each muscle is distinct and separate throughout its whole course; they can all be traced with facility. The disposition of the nerves and other parts of the tongue was also described. The examination of the tongue of an *Ameiva*, the common long-tail lizard, revealed a structure in all its features identical with that of the snake's tongue. This offers a confirmation of the view that lizards and snakes are closely related, for in no other class of reptiles has a snake-like tongue been observed. On the other hand, the tongue of the Chamæleon is peculiar. It has been previously studied by several authors, all of whom have committed important errors. The whole tongue is exceedingly complicated and difficult to understand. The arrangement of the muscles is the most remarkable yet observed among animals, and they cannot be homologized with the muscles of the tongue of any other animal, until our knowledge of the subject shall be greatly enlarged. Dr. Minot stated, while he had made new observations on the tongue of the chamæleon, that he had been led to recognize more clearly, than previous writers, the difficulty of explaining the mechanism of the organ. The tongue of birds presents a uniform type, distinct from that of any reptile. The tongue has its simplest and lowest form in the crocodiles, is much advanced in the snake and fissilingual lizards, remarkably transformed in the chamæleon, and presents a special type in birds. These points are brought out by numerous microscopical observations on the nerves, blood vessels and other parts.

SOME FACTS AND THEORIES BEARING A RELATION TO THE DISTRIBUTION OF ORGANIC FORMS ON THE GLOBE.†

By W. H. Davis.

The author commenced by pointing out the fact that the inorganic conditions which surround us are in a state of change, ceaseless, and ever varying; and illustrated this portion of the subject by references to denudation and redeposition of existing land surfaces. It was then shown that these inorganic changes could not take place without at the same time producing an effect on the organic world commensurate in some degree with the intensity of the inorganic change; this led up to the question of the same area of the earth's surface at successive periods possessing a varying fauna and flora, and the light thrown by palæontological investigation upon the changes of land surface that had taken place, and this knowledge of past conditions in its turn throwing an instructive light upon the former range of the various orders and genera of organic beings. Thus it was, that as there was a perpetual ebb and flow and ceaseless interchange of inorganic structure, so the forms and types of life affected by these influences are also in a continual and corresponding state of unrest, from the necessity of the two conditions being in harmony with each other, the organic and the inorganic.

The first problem, therefore, was, seeing that a change of the organism was necessitated by a variation in the conditions of existence, whether these changed conditions as they arise were of themselves capable of inducing structural differences in organized forms subjected to their influences. Starting with the negative view, it was pointed out that there were but two courses open to the organism affected—migration or extinction; but the former cause of itself involved a minor change of conditions, and as in the life history of the earth, a second, third, or greater number of migrations were necessitated, at last the probabilities were of the environment of the organism being so varied from its primary condition that extinction in this case must also ensue. Thus a form persisting through several or many periods of geological time would be impossible; but as this was contrary to many observed facts, the converse view was discussed, and actual structural modifications due to changed conditions referred to, as in the case of animals and plants introduced into West Africa, South America, and other regions. Mimicry was also instanced as evidence of the influence of inorganic form on living organisms. In man the Europeo-American nation of the United States was quoted as an instance of a race being formed under our very eyes.

It may, of course, be urged that the differences here pointed out are only of a character such as might be anticipated to have arisen, and that, pendulum-like, they vibrate through a very small arc, and in no way give rise to fresh species, still less to fresh genera. The next point, therefore, that comes in for consideration is whether these structural differences are ever commutative. We have seen that the change which can be produced in a single species is not an alteration in respect of one character only, but an alteration of many characters affecting different parts and portions of the same organism. Now these modifications, small as they are (in comparison with the question of a complete change of species), certainly did not leap into being in an instant, but have exhibited themselves gradually. Here, then, is a starting-point for the cumulative evidence. The changes themselves, even so far as they have gone at present, are but expressed cumulative results, and having become once established, it is only in accordance with what we have already seen to be the case, that with a further change of surroundings, a corresponding modification must ensue, or extinction alone must follow. But in this argument we are not altogether left to the evidence as visible to the eyes of mankind during the historic period, but a mass of the facts of palæontological history, some embryological investigations, and many zoological observations are absolutely inexplicable save on these grounds. If we trace the connections of the reptilian and avian forms, the progressive stages in time of the Equidæ, or the changes in structure of the more lowly Ammonitidæ, the same answers must be given, that the extremes observed in the respective groups have been the result of a cumulative modification due to the types of life being in a condition of instability, and ever seeking to bring themselves into harmony with their inorganic surroundings.

In further illustration of this portion of the subject, sympathetic modification or correlative adaptation may be noted, as when the change of one structure in an animal induces changes in other structures remote and apparently unconnected with it, as in the pigeon, the beak and toe lengthening and shortening in unison.

Degeneration was strongly insisted upon as a factor in producing fresh types, equally with progressive modification.

Passing, then, to the various views entertained as to the causes of the present geographical distribution of life, the doctrine of specific centres was explained, the author maintaining that this idea was, in effect, but the old teleological argument that every organism was created for a definite

* Read before the A. A. A. S., Boston, 1880.

† Read before the Metropolitan Scientific Association, London, England, Oct. 12, 1880.

and fixed purpose; that it was specially adapted to its original design; and, finally, fixed where its adaptation had fullest scope. This view was strongly opposed by arguments based upon parasitism, showing that there had been a gradual variation in design as different circumstances arose, and fresh materials came to hand.

NEW SPECIES OF MOLLUSCA AND ECHINODERMS.

Professor A. E. Verrill describes in detail, in the last number of the *American Journal of Science*, many new species of Marine Fauna, discovered on the southern coast of New England, during the present season by the large party, under the auspices of the U. S. Fish Commission, of which Professor Spencer F. Baird is a Commissioner.

The following is a list of the new species, described by Professor A. E. Verrill and Mr. Sanderson Smith, with the exception of *Luidia elegans*, described by Perrier.

MOLLUSCA.

Heteroteuthis tenera, sp. nov.—*Calliteuthis*, gen. nov. *Calliteuthis reversa*, sp. nov.—*Alloposus*, gen. nov. *Alloposus mollis*, sp. nov.—*Cymbulia calceola*, sp. nov.—*Pleurotoma Agassizii*, sp. nov.—*Pleurotoma Carpenteri*, sp. nov. *Scalaria Pourtalesii*, sp. nov.—*Scalaria Dalliana*, sp. nov.—*Lamellaria pellucida*, sp. nov. *Lepetella*, gen. nov. *Lepetella tubicola*, sp. nov.—*Lovenella Whiteavesii*, sp. nov.—*Calliostoma Bairdii*, sp. nov. *Margarita regalis*, sp. nov. *Margarita lamellosa*, sp. nov. *Turbonilla Rathbuni*, sp. nov. *Turbonilla formosa*, sp. nov.—*Pleurobranchæa tarda*, sp. nov. *Philine amabilis*, sp. nov. *Diaphana* (*Utriculus*) *gemma*, sp. nov. *Doris complanata*, sp. nov. *Cadulus Pandionis*, sp. nov. *Loripes lens*, sp. nov. *Modiola polita*, sp. nov. *Pecten fenestratus* (?)

ECHINODERMS.

Asterias Tanneri, sp. nov. *Odontaster*, gen. nov. *Odontaster hispidus*, sp. nov. *Archaster Americanus*, sp. nov. *Archaster Agassizii*, sp. nov. *Luidia elegans*.

A POISONOUS PRODUCT OF FERMENTED INDIAN CORN.

If the grains of Maize, or Indian Corn, be subjected to fermentation, they become dark in color without changing form, and are found to contain, in considerable amount, a body which may be extracted by alcohol. After the removal of the alcohol by distillation, there is obtained a residue, from which, after long standing, an oil separates. This oil is brown in color, has a sharp, bitter taste, and a sp. gr. of 0.925. It forms soaps with alkalies, is soluble in alcohol and ether, and becomes resinous when exposed to the air. It acts as a poison on the animal system, and in certain other properties is very similar to strychnia.—Coeytaux, *Chemiker-Zeitung*.

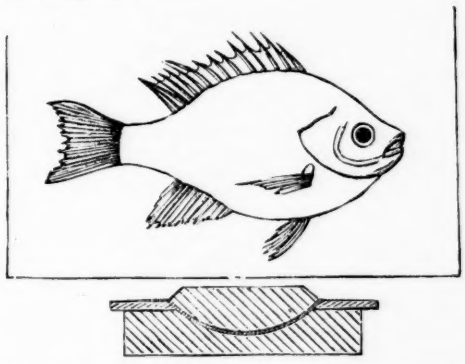
A PHYLLOXERA CONGRESS was held last month in Spain, at Saragossa, for the consideration of all topics connected with the grape Phylloxera. *The American Entomologist*, basing its opinion on the recovery of vines in Solano County, Cal., asserts its belief that the ravages of Phylloxera will have its day, and that from causes, not far to seek, the vine will again grow on the very lands which have been lately ravaged. For fear of the Phylloxera the Turkish Government have forbidden the introduction of any plants whatever into the territories of the Sultan.

IT is said that the Cochineal insect, which is a native of Mexico and Central America, thrives well in Florida.

CRYSTALS OF HÆMINE.—F. Högyes has examined crystals from the blood of men, oxen, swine, sheep, dogs, cats, rabbits, guinea-pigs, mice, pole cats, poultry, pigeons, geese, ducks, *Rana esculenta* and *temporaria*. All have one crystalline form only. They belong either to the monoclinar or triclinar system, probably the former.

TAXIDERMY.

Mr. Herman E. Davidson suggests an improvement in the art or method of mounting skins of fishes, which consists in forming a rigid mold of plastic material on the surface of the skin to be mounted before it is detached from the body of the fish, and thereafter removing the soft portion from the skin and stuffing or filling before it is removed from the mold, whereby the natural form and convexity of the fish are preserved.



This improvement may be understood by the annexed drawing. It will be seen that Mr. Davidson takes a moldboard having a portion removed corresponding with the outline of the body of the fish, exclusive of median fins, and inserts the body of the fish in the opening, the median fins resting against the face of the board, and forming a mold of plastic material upon the body of the fish projecting beyond the other face previous to removing the soft parts and stuffing the skin. The soft parts are then removed from the skin resting in the mold, and plastic material, adapted to solidify, is then poured in.

BOOKS RECEIVED.

THE JOURNAL OF NERVOUS AND MENTAL DISEASES, for October, 1880. Office No. 70 Monroe street, Chicago, and G P. Putnam's Sons, New York.

The opening article is by Dr. S. V. Clavenger, consisting of his paper read before the American Association for the Advancement of Science, entitled "Plan of the Cerebro-spinal Nervous System." An abstract of this paper was furnished to "SCIENCE," by Dr. Clevenger, and appeared in this jonrnal of the 11th of September last. Specialists should not fail to read the paper now presented in detail, as it forms an important addition to the literature of this subject. Dr. Edward C. Spitzka contributes two papers, the first a continuation of his "Contributions to Nervous and Mental Pathology," and "Contributions to Encephalic Anatomy." In the latter article Dr. Spitzka takes up the subject and methods of a study of the Ichthyopsidean brain. As we shall probably reproduce this article for the benefit of the readers of "SCIENCE," further reference to it at present is unnecessary. We cannot, however, refrain from expressing our satisfaction at finding that Dr. Spitzka continues to devote his attention to original research in this direction; our knowledge of human anatomy has been greatly extended by the investigation, of naturalists, into the lower forms of life, and if higher results are attained, it will be by such indefatigable and intelligent work as is manifested in this paper of Dr. Spitzka. The other articles in this number are, "Contributions to Psychiatry by James G. Kiernan, M. D. A case of Diffuse Myelitis, by Dr. J. C. Shaw, and Dr. John S. Woodside. A case of Acute Myelitis, by S. G. Webber, M. D., and a case of Meningo-encephalitis, by H. M. Bannister, M. D.

DO SHARKS SWALLOW THEIR YOUNG FOR PROTECTION?

To the Editor of Science:

SIR: In the New York *Tribune* for July 7, 1880, under the heading "A Female Shark Captured," was printed a statement made to a reporter by Mr. Eugene G. Blackford, well and favorably known to the community, not only as one of the largest dealers in fish at Fulton Market, but also as an enthusiastic co-operator with the United States Fish Commission. The essential parts of the statement are as follows: "A Porbeagle shark (*Lamna punctata*)* was caught off Great Neck, Long Island, and came into my possession not more than seven hours after death. From the immense size of her stomach I thought she must have swallowed a barrel or two of moss-bunkers, and to gratify my curiosity I opened her. I found ten little shark, evidently her offspring, and all just the same size—exactly two feet long. I should say they were about six months old, for a shark when hatched from the egg measures about four inches. It has been a disputed question among fishermen whether young sharks in time of danger do not seek safety in their mother's stomach. I think this case proves that they do, for the little ones were perfectly sound, with no mark of digestion upon them."

In answer to a request for more explicit information, Mr. Blackford, August 25, wrote me a letter from which, with his permission, I extract the following: "Just as the men were about to open the shark I was called away. When I returned they showed me the ten young, but I did not preserve them. The men said they were in the stomach, but the viscera had been thrown away, so I could not verify their statement. As I understand it, sharks are oviparous and not viviparous, so they could not have been in the womb. Will you kindly let me have your opinion on this? Should another specimen ever come into my hands I shall take great care that it is scientifically examined if you think it is of importance."

In reply, I informed Mr. Blackford that many species of sharks bring forth living young, and expressed the opinion that the little ones found by his men were really in the enlarged oviducts rather than in the true stomach, and suggested that he should publish some qualification of the original account, or authorize me to do so for him.

As time passed without my hearing from him, I concluded that he was preparing a note upon the subject, and hoped, moreover, that no journal under scientific supervision would give even a qualified sanction to the original statement without making enquiries like my own. Nevertheless, the paragraph in the *Tribune* was copied, substantially, into the *Scientific American* for July 31, and formed the basis of the following "Zoological Note" in the *American Naturalist* for October: "Mr. E. G. Blackford states that ten sharks, two feet in length and apparently about six months old, were taken from the stomach of a mackerel shark (*Lamna punctata*), as if they had got there to avoid danger. Still, it is probable that sharks may eat their young."

Upon hearing of this dissemination of the error, Mr. Blackford wrote me on the 19th and 28th of October: "I was under the impression that I wrote you before to make what corrections, you saw proper, to the shark story. I have given corrected statements to the *World* newspaper, and to *Forest and Stream*, and should be only too happy to have you make further corrections, as there is nothing I regret so much as to have anything purporting to emannate from me that looks like a yarn."

Availing myself of Mr. Blackford's permission I repeat, that, while it may not be right to deny the possibility of young sharks seeking refuge from danger—as do some snakes—by entering the mouth of the parent, the case in question furnishes not a particle of evidence in favor of that idea, and the little sharks were probably the unborn young, closely packed in the enlarged oviducts of the mother.

B. G. WILDER.

CORNELL UNIVERSITY, ITHACA, N. Y., *Nov.* 4, 1880.

* It is also known as the Mackerel shark, and ha been named *Lamna spallanvanii*, and *Isuropis dekayi*.

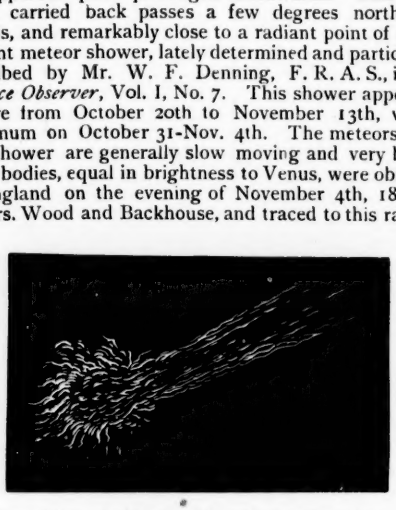
A FINE BOLIDE.

BY EDWIN F. SAWYER.

A bolide, the most brilliant I have ever witnessed, appeared on the evening of October 25th, at 8 h. 10 min. C. M. T. It commenced near ε Persei, at R. A. 55° + 40° Dec., and exploded above α Aurigae (Capella), at R. A. 76° + 52° Dec. When first observed it was as bright as a 1st mag. star, and of a deep orange color. As it slowly proceeded it grew rapidly brighter, (its color in the meanwhile changing to light yellow and then white) first exceeding 2[(Jupiter) in brilliancy, and then ♀ (Venus), and at the moment of the explos.on was many times brighter than the latter planet. Several distinct flashes were noted during its flight. At the moment of explosion (accompanied by a very vivid flash) the nucleus appeared somewhat elongated and of a pale green color, while the points of light and sparks radiating from it were of a beautiful red. During the first half of its course there appeared to be little or no streak accompanying the bolide; but during the latter part of its path a broad and intensely white streak was observed, which, however, disappeared almost immediately after the extinction of the nucleus.

The bolide was three and a half seconds in traversing a path of 17°, its velocity gradually increasing up to the point of explosion. No detonation was heard, although particularly listened for.

The radiant point of this bolide was somewhere along its apparent path prolonged backwards. This path when carried back passes a few degrees north of ε Arietis, and remarkably close to a radiant point of an important meteor shower, lately determined and particularly described by Mr. W. F. Denning, F. R. A. S., in the *Science Observer*, Vol. I, No. 7. This shower appears to endure from October 20th to November 13th, with a maximum on October 31-Nov. 4th. The meteors from this shower are generally slow moving and very bright. Two bodies, equal in brightness to Venus, were observed in England on the evening of November 4th, 1877, by Messrs. Wood and Backhouse, and traced to this radiant.



The position of this special meteor stream is at about R. A. 43° + 22° near ε Arietis. Several quite bright and short meteors (including one nearly stationary) belonging to this shower were observed by the writer from Nov. 7 to 19th, 1879, and giving a well determined position as at R. A, 47° + 24°. A rough sketch of the bolide as it appeared at the moment of explosion is here given.

Duplicate observations of this fine bolide are desired and would be of great value.

Cambridgeport, Oct. 31st, 1880.